## CLAIMS

**WHAT IS CLAIMED IS:**

1. An infrared microscope system receiving an infrared input beam from a source of infrared radiation comprising:

(a) an infrared detector;

(b) microscope optics arranged to receive an infrared light beam and focus it onto a sample at a sample position and to transmit light through the sample to provide a transmitted light beam;

(c) an aperture element having an aperture therein through which a beam of infrared light may be passed;

(d) infrared optical elements defining a beam path for the input beam from the infrared source through the aperture to the microscope optics, and a beam path for the transmitted beam from the microscope optics through the aperture to an output beam path and thence to the detector; and

(e) at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope optics to the output beam path and thence to the detector that does not pass through the aperture of the aperture element.

2. The system of Claim 1 further comprising a source of infrared radiation providing an infrared input beam to the infrared optical elements.

3. The system of Claim 2 wherein the source of infrared radiation is an infrared spectrometer.

4. An infrared microscope system receiving an infrared input beam from a source of infrared radiation comprising:

(a) an infrared detector;

(b) microscope optics arranged to receive an infrared light beam and focus it onto a sample at a sample position and to reflect light from the sample back through the optics to provide a reflected light beam and to transmit light through the sample to provide a transmitted light beam;

(c) an aperture element having an aperture therein through which a beam of infrared light may be passed;

(d) infrared optical elements defining a beam path for the input beam from the infrared source through the aperture to the microscope optics, and a beam path for the reflected beam from the microscope optics through the aperture to an output beam path and thence to the detector, and a beam path for the transmitted beam from the microscope optics through the aperture to the output beam path and thence to the detector; and

(e) at least one mirror element selectively interposable in the beam path from the source to the aperture element to define when interposed a beam path from the source to the microscope optics that does not pass through the aperture of the aperture element, at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope optics to the detector that does not pass through the aperture of the aperture element, and at least one mirror element selectively interposable in the reflected beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope optics to the detector that does not pass through the aperture of the aperture element.

5. The system of Claim 4 further comprising a source of infrared radiation providing an infrared input beam to the infrared optical elements.

6. The system of Claim 5 wherein the source of infrared radiation is an infrared spectrometer.

7. An infrared microscope system receiving an infrared input beam from a source of infrared radiation comprising:

(a) an infrared detector;

(b) microscope optics arranged to receive an infrared light beam and focus it onto a sample at a sample position and to reflect light from the sample back through the optics to provide a reflected light beam;

(c) an aperture element having an aperture therein through which a beam of infrared light may be passed;

(d) infrared optical elements defining a beam path for the input beam from the infrared source through the aperture to the microscope optics, and a beam path for the reflected beam from the microscope optics through the aperture to an output beam path and thence to the detector; and

(e) at least one mirror element selectively interposable in the reflected beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope optics to the detector that does not pass through the aperture of the aperture element.

8. The system of Claim 7 further comprising a source of infrared radiation providing an infrared input beam to the infrared optical elements.

9. The system of Claim 8 wherein the source of infrared radiation is an infrared spectrometer.

10. The system of Claim 7 further including at least one mirror element selectively interposable in the beam path from the source to the aperture element to define when interposed a beam path from the source to the microscope optics that does not pass through the aperture of the aperture element.

11. The system of Claim 10 further including infrared optical elements defining a beam path for a transmitted beam from the microscope optics through the aperture to an output beam path and thence to the detector; and at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope optics to the output beam path and thence to the detector that does not pass through the aperture of the aperture element.

12. The system of Claim 1, 4 or 11 wherein the microscope optics include an objective receiving an incoming beam along an incoming beam path and providing a reflected return beam from the sample on the incoming beam path, and a condenser receiving infrared light transmitted through a sample and providing the transmitted beam from the microscope optics.

13. The system of Claim 12 wherein the objective and the condenser are formed with Cassegrain reflective optics.

14. The system of Claim 12 wherein the infrared optical elements defining a beam path for the input beam from the infrared

source through the aperture to the microscope optics include a first curved mirror receiving a collimated input beam to reflect and focus the beam through the aperture of the aperture element, a second curved mirror receiving the beam passed through the aperture and reflecting the beam into a collimated beam, a first flat mirror receiving the collimated beam from the second curved mirror and reflecting the collimated beam on a beam path to a first reflective element which reflects the infrared beam to the objective of the microscope optics;

wherein the infrared optical elements defining a beam path for the transmitted beam from the microscope condenser through the aperture to the output beam path and thence to the detector include a second reflective element positioned to receive the collimated output beam from the condenser and direct the infrared light on a beam path to a second flat mirror, the second flat mirror reflecting the collimated beam on a beam path to a third curved mirror, the third curved mirror positioned to reflect the collimated beam into a focused beam that is directed through the aperture of the aperture element, a fourth curved mirror positioned to receive the beam passed through the aperture element from the third curved mirror and to reflect the beam into a collimated beam onto the output beam path;

and wherein the at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element comprises a mirror which is moveable into the beam path between the second flat mirror and the third curved mirror to reflect the collimated beam from the second flat mirror and a output beam path mirror moveable within the output beam path to receive the beam reflected from the mirror in the beam path between the second flat mirror and the third curved mirror and reflecting the beam onto the output beam path without passing through the aperture element.

15. The system of Claim 14 including an input beam path mirror which is selectively interposable in the input beam path to reflect the input beam onto a beam path leading directly to the first reflective element without passing through the aperture.

16. The system of Claim 14 wherein the first and second reflective elements are dichroic reflectors that reflect infrared and pass visible light.

17. The system of Claim 12 wherein the detector comprises an array detector having multiple detecting elements.

18. The system of Claim 12 wherein the detector has a single detecting element.

19. The system of Claim 4 wherein the microscope optics include an objective receiving an incoming beam along an incoming beam path and providing a reflected return beam from the sample on the incoming beam path, and a condenser receiving infrared light transmitted through a sample and providing the transmitted beam from the microscope optics;

wherein the infrared optical elements defining a beam path for the input beam from the infrared source through the aperture to the microscope optics include a first curved mirror receiving a collimated input beam to reflect and focus the beam through the aperture of the aperture element, a second curved mirror receiving the beam passed through the aperture and reflecting the beam into a collimated beam, a first flat mirror receiving the collimated beam from the second curved mirror and reflecting the collimated beam on a beam path to a first reflective element

which reflects the infrared beam to the objective of the microscope optics;

wherein the infrared optical elements defining a beam path for the transmitted beam from the microscope condenser through the aperture to the output beam path and thence to the detector include a second reflective element positioned to receive the collimated output beam from the condenser and direct the infrared light on a beam path to a second flat mirror, the second flat mirror reflecting the collimated beam on a beam path to a third curved mirror, the third curved mirror positioned to reflect the collimated beam into a focused beam that is directed through the aperture of the aperture element, a fourth curved mirror positioned to receive the beam passed through the aperture element from the third curved mirror and to reflect the beam into a collimated beam onto the output beam path;

wherein the at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element comprises a mirror which is moveable into the beam path between the second flat mirror and the third curved mirror to reflect the collimated beam from the second flat mirror and a output beam path mirror moveable within the output beam path to receive the beam reflected from the mirror in the beam path between the second flat mirror and the third curved mirror and reflecting the beam onto the output beam path without passing through the aperture element;

wherein the at least one mirror element selectively interposable in the beam path from the source to the aperture element comprises an input beam path mirror which is selectively interposable in the input beam path to reflect the input beam onto a beam path leading directly to the first reflective element without passing through the aperture;

and wherein the optical elements defining a beam path for the reflected beam from the microscope optics through the aperture to the output beam path and thence to the detector include the optical mirror elements directing the input beam to the objective of the microscope optics and a first sluice mirror selective interposable partially into the input beam path to pass part of the input beam to the optical elements directing the beam to the objective, and wherein the reflected beam from the objective travels along the same beam path as the incoming beam directed to the objective and in travels in parallel therewith such that the reflected beam when passing along the input beam path is intercepted by the first sluice mirror when interposed and is reflected by the first sluice mirror onto the output beam path.

20. The system of Claim 19 wherein the at least one optical element selectively interposable in the beam path from the source to the aperture element comprises a second input beam path mirror which when interposed in the input beam path reflects the input beam away from the aperture element to bypass the aperture, and wherein the first flat mirror is moveable from a position reflecting the beam from the second curved mirror to a position in which it reflects the beam reflected from the second input beam path mirror onto a beam path leading to the first reflecting element to thereby bypass the aperture element.

21. The system of Claim 19 wherein the at least one optical element selectively interposable in the reflected beam path from the microscope optics to the aperture element comprises a second sluice mirror selectively interposable partially into the beam path between the first flat mirror and the first reflecting element to pass a portion of the incoming beam on the beam path so that the incoming beam and the

beam reflected from the sample occupy the same beam path in parallel with each other and wherein the second sluice mirror when interposed intercepts the reflected beam on the beam path between the first reflecting element and the first flat mirror to reflect the reflected beam toward a mirror which is interposed to reflect the reflected beam onto the output beam path so as to bypass the aperture.

22. The system of Claim 19 wherein the at least one optical mirror element selectively interposable in the beam path from the source to the aperture element and in the reflected beam path from the microscope optics to the aperture element comprise the first sluice mirror selectively interposed partially into the first beam path, a first input beam path mirror interposed to reflect the incoming beam onto the beam path to the first reflective element which reflects the incoming beam to the microscope objective, with the reflected beam from the objective returning on the same beam path as the incoming beam in parallel therewith and such that it is reflected by the first input beam path mirror onto the input beam path in parallel with the input beam where it is intercepted by the first sluice mirror and reflected onto the output beam path.

23. The system of Claim 19 wherein the detector comprises an array detector having multiple detecting elements.

24. The system of Claim 19 wherein the first and second reflective elements are dichroic reflectors that reflect infrared and pass visible light.

25. A method for carrying out infrared microscopy comprising:

(a) directing an infrared input beam on a beam path that focuses the beam onto and through an aperture and thence to a microscope objective at which the beam is focused at a sample, receiving the beam passed through the sample by a microscope condenser and directing a transmitted beam from the condenser on a beam path on which the beam is focused back onto and through the aperture, and directing the beam passed through the aperture to an infrared detector; and

(b) redirecting the transmitted beam from the condenser so that the transmitted beam bypasses the aperture element and is directed to the detector.

26. The method of Claim 25 further including redirecting the input beam to bypass the aperture and directing the input beam to the objective to focus the input beam on the sample without passing through the aperture.

27. The method of Claim 25 further including directing infrared light reflected from the sample through the objective to form a reflected beam and focusing the reflected beam onto and through the aperture and directing the beam passed through the aperture to a detector, and redirecting the reflected beam reflected from the objective to bypass the aperture and directing the reflected beam to the detector.

28. A method for carrying out infrared microscopy comprising:

(a) directing an infrared input beam on a beam path that focuses the beam onto and through an aperture and thence to a microscope objective at which the beam is focused at a sample, directing infrared light reflected from the sample through the objective to form a reflected beam and focusing the reflected beam onto and through the aperture and directing the beam passed through the aperture to an infrared detector; and

(b) redirecting the reflected beam from the objective to bypass the aperture and directing the reflected beam to the detector.

29. The method of Claim 28 further including receiving the beam passed through the sample by a microscope condenser and directing a transmitted beam from the condenser on a beam path on which the beam is focused back onto and through the aperture, and directing the beam passed through the aperture to an infrared detector and redirecting the transmitted beam from the condenser so that the transmitted beam bypasses the aperture element and directing the transmitted beam to the detector.

30. The method of Claim 28 further including redirecting the input beam to bypass the aperture and directing the input beam to the objective to focus the input beam on the sample without passing through the aperture.

31. An infrared microscope system receiving an infrared input beam from a source of infrared radiation comprising:

(a) an infrared detector;

(b) microscope optics arranged to receive an infrared light beam and focus it onto a sample at a sample position and to reflect light from the sample back through the optics to provide a reflected light beam;

(c) an aperture element having an aperture therein through which a beam of infrared light may be passed;

(d) infrared optical elements defining a beam path for the input beam from the infrared source through the aperture to the microscope optics, and a beam path for the reflected beam from the microscope optics through the aperture to an output beam path and thence to the detector; and

(e) at least one mirror element selectively interposable in the beam path from the source to the aperture element to define when interposed a beam path from the source to the microscope optics that does not pass through the aperture of the aperture element.

32. The system of Claim 31 further comprising a source of infrared radiation providing an infrared input beam to the infrared optical elements.

33. The system of Claim 32 wherein the source of infrared radiation is an infrared spectrometer.

34. The system of Claim 31 further including infrared optical elements defining a transmitted beam path from the microscope optics through the aperture to an output beam path and thence to the detector; and at least one mirror element selectively interposable in the transmitted beam path from the microscope optics to the aperture element to define when interposed a beam path from the microscope

optics to the output beam path and thence to the detector that does not pass through the aperture of the aperture element.

35. A method for carrying out infrared microscopy comprising:

(a) directing an infrared input beam on a beam path that focuses the beam onto and through an aperture and thence to a microscope objective at which the beam is focused at a sample, directing infrared light reflected from the sample through the objective to form a reflected beam and focusing the reflected beam onto and through the aperture and directing the beam passed through the aperture to an infrared detector; and

(b) redirecting the input beam to bypass the aperture and directing the input beam to the objective to focus the input beam on the sample without passing through the aperture.

36. The method of Claim 35 further including receiving the beam passed through the sample by a microscope condenser and directing a transmitted beam from the condenser on a beam path on which the beam is focused back onto and through the aperture, and directing the beam passed through the aperture to an infrared detector and redirecting the transmitted beam from the condenser so that the transmitted beam bypasses the aperture element and directing the transmitted beam to the detector.

37. The method of Claim 35 further including redirecting the reflected beam from the objective to bypass the aperture and directing the reflected beam to the detector.

38. A method for carrying out infrared microscopy comprising:

(a) directing an infrared input beam on a beam path that focuses the beam onto and through an aperture and thence to a microscope objective at which the beam is focused at a sample, receiving the beam passed through the sample by a microscope condenser and directing a transmitted beam from the condenser on a beam path on which the beam is focused back onto and through the aperture, and directing the beam passed through the aperture to an infrared detector; and

(b) redirecting the input beam to bypass the aperture and directing the input beam to the objective to focus the input beam on the sample without passing through the aperture and redirecting the transmitted beam from the condenser so that the transmitted beam bypasses the aperture element and is directed to the detector.

39. The method of Claim 38 further including directing infrared light reflected from the sample through the objective to form a reflected beam and focusing the reflected beam onto and through the aperture and directing the beam passed through the aperture to a detector, and redirecting the reflected beam reflected from the objective to bypass the aperture and directing the reflected beam to the detector.

40. The method of Claim 38 further including focusing the transmitted beam that bypasses the aperture element to form an image of the sample on an array detector.

41. A method for carrying out infrared microscopy comprising:

(a) directing an infrared input beam on a beam path that focuses the beam onto and through an aperture and thence to a microscope objective at which the beam is focused at a sample, directing infrared light reflected from the sample through the objective to form a reflected beam and focusing the reflected beam onto and through the aperture and directing the beam passed through the aperture to an infrared detector; and

(b) redirecting the input beam to bypass the aperture and directing the input beam to the objective to focus the input beam on the sample without passing through the aperture and redirecting the reflected beam from the objective to bypass the aperture and directing the reflected beam to the detector.

42. The method of Claim 41 further including receiving the beam passed through the sample by a microscope condenser and directing a transmitted beam from the condenser on a beam path on which the beam is focused back onto and through the aperture, and directing the beam passed through the aperture to a detector and redirecting the transmitted beam from the condenser so that the transmitted beam bypasses the aperture element and directing the transmitted beam to the detector.

43. The method of Claim 41 further including focusing the reflected beam that bypasses the aperture element to form an image of the sample on an array detector.